

# PS1-184: A set of CR detectors installed at Syowa Station, in the Antarctic, for space weather study

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A set of Cosmic Ray (CR) detectors was recently installed in Syowa Station, in the Antarctic, to observe CR neutron and muon simultaneously at the same point. The observing system started working in Feb., 2018 and are stable with high operation rate, >93%. We describe these systems and report a first space weather phenomenon identified by these detectors.

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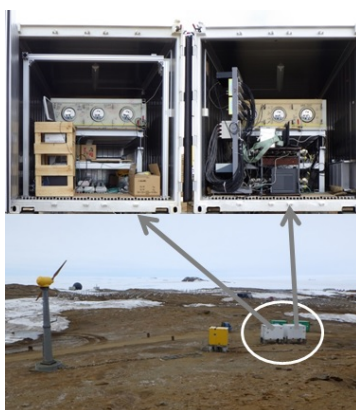
## 1. Introduction

Arctic/Antarctic regions are suitable for low energy Cosmic Rays (CRs) observation on the ground, because of the low geomagnetic cutoff rigidity for incident CRs. That is one of the reason that many Neutron Monitors (NMs) are operating in Arctic/Antarctic and high latitude regions. Among all of NMs, Space Ship Earth (SSE) contributes to space weather study by network observations (e.g. [1]). Global Muon Detector Network (GMDN), on the other hand, is a network observing CR muons. The GMDN monitors all sky for CR muon, which have a response to primary CRs with energy 5 times higher than NMs, and also contributes to space weather (e.g. [2]). It is natural to plan a simultaneous observation of CR neutrons and muons. Therefore, a set of CR detectors started simultaneous observation of CR neutrons and muons at Syowa Station, in Antarctic, on February 1st, 2018.

## 2. Installation

Syowa Station was established in 1957 on East Ongul Island, LützowHolm Bay ( $69^{\circ}00'16''\text{S}$ ,  $39^{\circ}34'54''\text{E}$ ) and was/is used as a year-round scientific research home base. Installation operation was done by the 59th of Japan Antarctic Research Expedition (JARE59) in 2017-2018. All of the CR equipment had been transported on the 5 week long voyage of Shirase, an Icebreaker.

Setting up was started with making foundations at the beginning of January 2018. Two refrigeration containers were set one meter high above ground on the foundation. NMs were framed into the two containers and a multi-directional MD was set into one of them beneath the NM (figure 1).

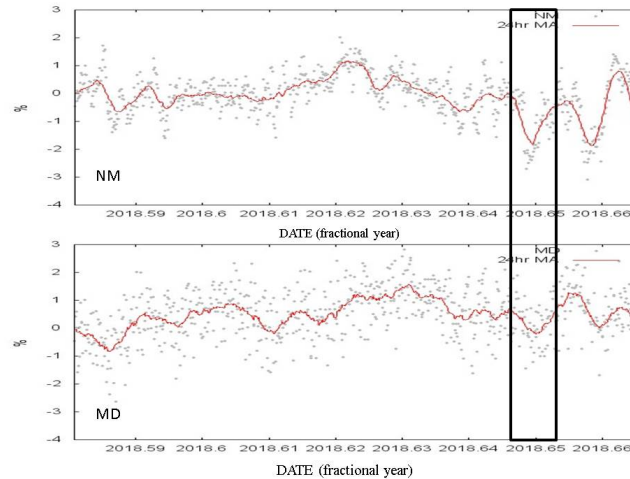


**Figure 1:** NM and MD set in refrigeration containers

Except for a few days initially, there have been no serious problems and thereby a high operation rate. It should be noted that the power generator at Syowa Station is routinely shut-off for emergency response training once a year.

### 3. A space weather event

The first space weather phenomenon was observed by the SyowaNM and SyowaMD in August 2018 during a geomagnetic storm. Figure 2 shows count rate of SyowaNM and SyowaMD during the event.



**Figure 2:** Count rate of SyowaNM and the vertical channel of SyowaMD in August, 2018. Dots show hourly value and red lines are showing 24 hours moving average. On 25-26 of August, bounded by black line, correspond to the geomagnetic storm caused by a CME. CR intensity decrease is observed. There is an interesting variation after the event. Structure of this CME can be analysed with GMDN data.

This event is a CME driven event. Thus, analysis with GMDN data will show us variation of CR anisotropy and impart detailed informations as other CME events ([3]).

### 4. Summary

A new CR observatory performing simultaneous observation of CR neutron and muon started stable operation. A CME event was detected by this new detector systems in August, 2018. CR anisotropy analysis with GMDN data will help to understand the structure of the Flux Rope for this event. SSE data is also useful to analyse CME event. Simultaneous observation of CR neutron and muon at Syowa Station in Antarctic is valuable to integrate individual results from GMDN and SSE.

### 5. Acknowledgment

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is started to be published at <http://polaris.nipr.ac.jp/~cosmicrays/en.html> supported by ROIS-DS-JOINT2018.

## References

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- [2] Okazaki et al., *Astrophys. J.*, **681**, 693, 2008
- [3] Kuwabara et al., *J. of Geophys. Res.*, **114**, A5, A05109, 2009